ml-lab

December 28, 2023

EXPERIMENT 1

[42]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.datasets import load_iris
from sklearn.metrics import accuracy_score,confusion_matrix
from sklearn.model_selection import train_test_split
```

[43]:
```
knc=KNeighborsClassifier(n_neighbors=5)
```

[44]:
```
data=load_iris()
X=data.data
Y=data.target
```

[45]:
```
x_train,x_test,y_train,y_test = train_test_split(X,Y,test_size=0.
↪3,random_state=42)
```

[46]:
```
knc.fit(x_train,y_train)
```

[46]:
```
KNeighborsClassifier()
```

[47]:
```
y_pred=knc.predict(x_test)
```

[48]:
```
for i in range(len(y_pred)):
    if y_pred[i] == y_test[i]:
        print("Correct.")
    else:
        print("Wrong")
```

```
Correct.
Correct.
Correct.
Correct.
Correct.
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Correct.
Correct.
Correct.
Correct.
```

```
Correct.
Correct.
Correct.
Correct.
Correct.
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Correct.
Correct.
```

[49]:
```python
print("Accuracy : ",accuracy_score(y_test,y_pred))
```

```
Accuracy :  1.0
```

[50]:
```python
print("Confusion Matrix : ",confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix :  [[19  0  0]
 [ 0 13  0]
 [ 0  0 13]]
```

EXPERIMENT 2

[51]:
```
from sklearn.cluster import KMeans
from sklearn.mixture import GaussianMixture
import sklearn.metrics as metrics
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import load_iris
```

[52]:
```
dataset=load_iris()
```

[53]:
```
dataset.feature_names
```

[53]:
```
['sepal length (cm)',
 'sepal width (cm)',
 'petal length (cm)',
 'petal width (cm)']
```

[54]:
```
dataset.keys()
```

[54]:
```
dict_keys(['data', 'target', 'frame', 'target_names', 'DESCR', 'feature_names',
'filename', 'data_module'])
```

[55]:
```
X=pd.DataFrame(dataset.data)
X.columns=['sepal_length','sepal_width','petal_length','petal_width']
```

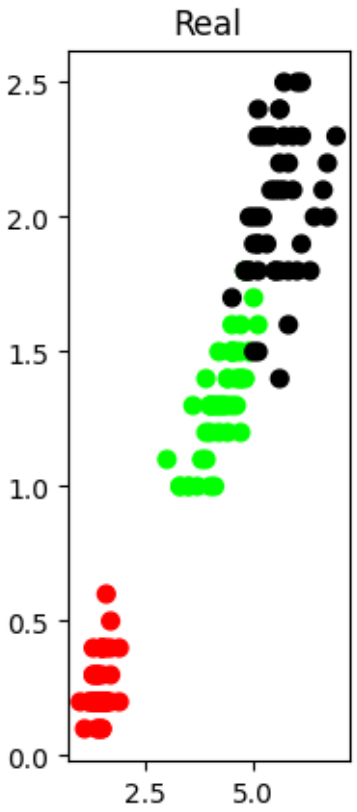
[56]:
```
Y=pd.DataFrame(dataset.target)
Y.columns=['Targets']
```

[57]:
```
plt.figure(figsize=(14,10))
colormap=np.array(['red','lime','black'])
```

```
<Figure size 1400x1000 with 0 Axes>
```

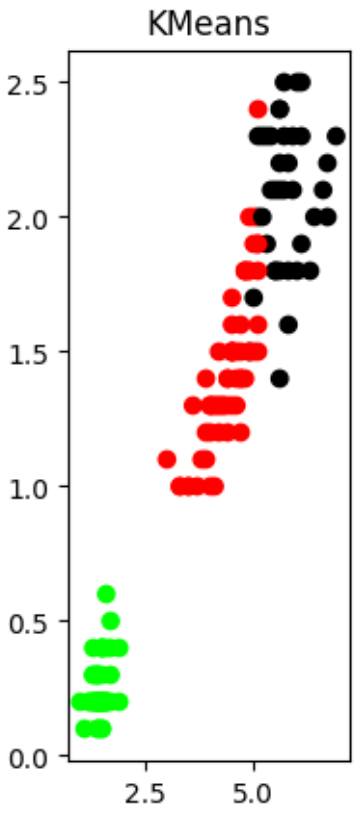
[58]:
```
# REAL PLOT
plt.subplot(1,3,1)
plt.title('Real')
plt.scatter(X.petal_length,X.petal_width,c=colormap[Y.Targets],s=40)
```

[58]:
```
<matplotlib.collections.PathCollection at 0x216f6b8ee90>
```



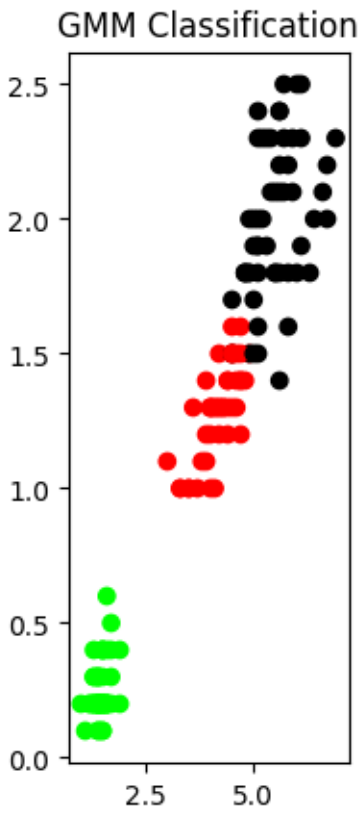
[59]:
```
# K-PLOT
model=KMeans(n_clusters=3, random_state=0).fit(X)
plt.subplot(1,3,2)
plt.title('KMeans')
plt.scatter(X.petal_length,X.petal_width,c=colormap[model.labels_])

print('The accuracy score of K-Mean: ',metrics.accuracy_score(Y, model.labels_))
print('The Confusion matrixof K-Mean:\n',metrics.confusion_matrix(Y, model.
 ↪labels_))
```

```
C:\Users\LENOVO\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.10_qbz5
n2kfra8p0\LocalCache\local-packages\Python310\site-
packages\sklearn\cluster\_kmeans.py:1416: FutureWarning: The default value of
`n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init`
explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)

The accuracy score of K-Mean:  0.24
The Confusion matrixof K-Mean:
 [[ 0 50  0]
 [48  0  2]
 [14  0 36]]
```



[60]:
```
# GMM PLOT
gmm=GaussianMixture(n_components=3, random_state=0).fit(X)
y_cluster_gmm=gmm.predict(X)
plt.subplot(1,3,3)
plt.title('GMM Classification')
plt.scatter(X.petal_length,X.petal_width,c=colormap[y_cluster_gmm])

print('The accuracy score of EM: ',metrics.accuracy_score(Y, y_cluster_gmm))
print('The Confusion matrix of EM:\n ',metrics.confusion_matrix(Y,␣
 ↪y_cluster_gmm))
```

```
The accuracy score of EM:  0.3333333333333333
The Confusion matrix of EM:
  [[ 0 50  0]
 [45  0  5]
 [ 0  0 50]]
```



EXPERIMENT 3

[61]:
```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
```

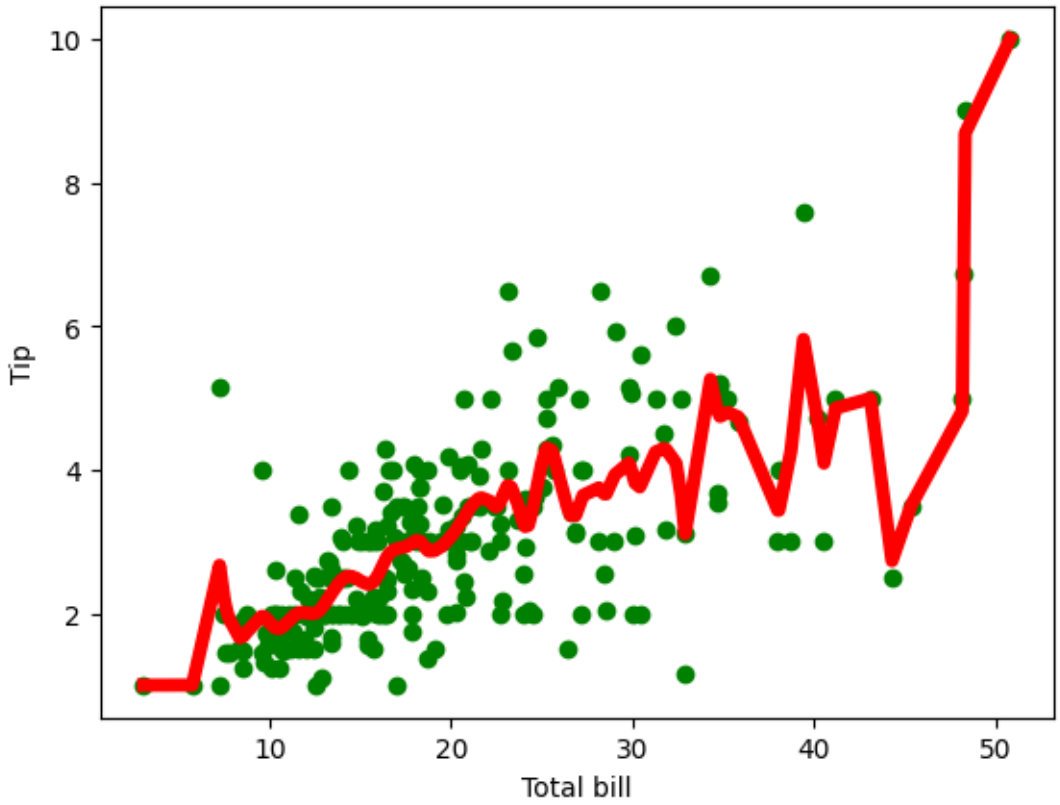
[62]:
```
def kernel(point, xmat, k):
    m,n = np.shape(xmat)
    weights = np.mat(np.eye((m)))
    for j in range(m):
        diff = point - X[j]
        weights[j,j] = np.exp(diff*diff.T/(-2.0*k**2))
    return weights
```

[63]:
```
def localWeight(point, xmat, ymat, k):
    wei = kernel(point,xmat,k)
    W = (X.T*(wei*X)).I*(X.T*(wei*ymat.T))
    return W
```

[64]:
```
def localWeightRegression(xmat, ymat, k):
    m,n = np.shape(xmat)
```

```
    ypred = np.zeros(m)
    for i in range(m):
        ypred[i] = xmat[i]*localWeight(xmat[i],xmat,ymat,k)
    return ypred
```

[65]:
```
# load data points
data = pd.read_csv('10-dataset.csv')
bill = np.array(data.total_bill)
tip = np.array(data.tip)

#preparing and add 1 in bill
mbill = np.mat(bill)
mtip = np.mat(tip)

m= np.shape(mbill)[1]
one = np.mat(np.ones(m))
X = np.hstack((one.T,mbill.T))

#set k here
ypred = localWeightRegression(X,mtip,0.5)
SortIndex = X[:,1].argsort(0)
xsort = X[SortIndex][:,0]

fig = plt.figure()
ax = fig.add_subplot(1,1,1)
ax.scatter(bill,tip, color='green')
ax.plot(xsort[:,1],ypred[SortIndex], color = 'red', linewidth=5)
plt.xlabel('Total bill')
plt.ylabel('Tip')
plt.show();
```



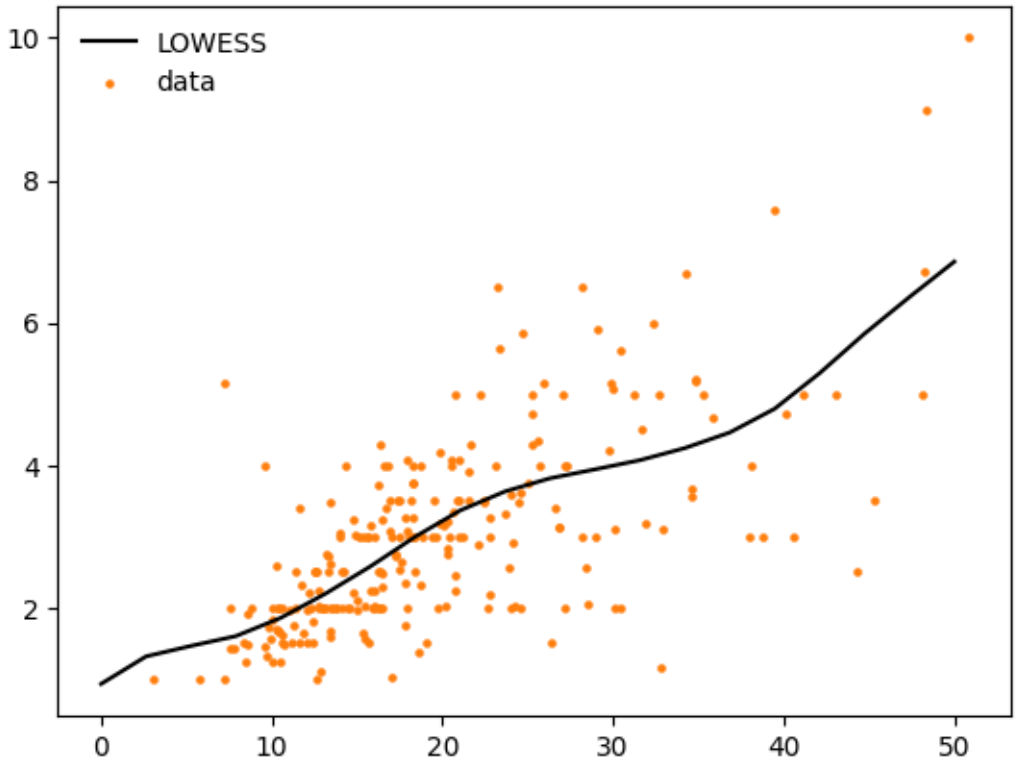
OR

[66]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from moepy import lowess
```

[67]:
```
data = pd.read_csv('10-dataset.csv')
x=np.array(data.total_bill)
y=np.array(data.tip)

#Model fitting
lowess_model = lowess.Lowess()
lowess_model.fit(x,y)

#Model Prediction
x_pred = np.linspace(0,50,20)
y_pred = lowess_model.predict(x_pred)

#Plotting'
plt.plot(x_pred,y_pred,"-",label="LOWESS",color='k',zorder=3)
```

```
plt.scatter(x,y,label='data',color='C1',s=5,zorder=1)
plt.legend(frameon=False)
```

[67]: <matplotlib.legend.Legend at 0x216f5d2e7a0>



EXPERIMENT 4

[15]:
```
import numpy as np
from sklearn.datasets import load_iris
import pandas as pd
X = np.array(([2, 9], [1, 5], [3, 6]), dtype=float)
y = np.array(([92], [86], [89]), dtype=float)
X = X/np.amax(X,axis=0) #maximum of X array longitudinally
y = y/100
```

[16]:
```
#Sigmoid Function
def sigmoid (x):
    return 1/(1 + np.exp(-x))
```

[17]:
```
#Derivative of Sigmoid Function
def derivatives_sigmoid(x):
    return x * (1 - x)
```

[18]:
```
#Variable initialization
epoch=5 #Setting training iterations
lr=0.1 #Setting learning rate
```

[19]:
```
inputlayer_neurons = 2 #number of features in data set
hiddenlayer_neurons = 3 #number of hidden layers neurons
output_neurons = 1 #number of neurons at output layer
#weight and bias initialization
```

[20]:
```
wh=np.random.uniform(size=(inputlayer_neurons,hiddenlayer_neurons))
bh=np.random.uniform(size=(1,hiddenlayer_neurons))
wout=np.random.uniform(size=(hiddenlayer_neurons,output_neurons))
bout=np.random.uniform(size=(1,output_neurons))
```

[21]:
```
#draws a random range of numbers uniformly of dim x*y
for i in range(epoch):
    #Forward Propogation
    hinp1=np.dot(X,wh)
    hinp=hinp1 + bh
    hlayer_act = sigmoid(hinp)
    outinp1=np.dot(hlayer_act,wout)
    outinp= outinp1+bout
    output = sigmoid(outinp)

    #Backpropagation
    EO = y-output
    outgrad = derivatives_sigmoid(output)
    d_output = EO * outgrad
    EH = d_output.dot(wout.T)
    hiddengrad = derivatives_sigmoid(hlayer_act)#how much hidden layer wts␣
 ↪contributed to error
    d_hiddenlayer = EH * hiddengrad

    wout += hlayer_act.T.dot(d_output) *lr   # dotproduct of nextlayererror and␣
 ↪currentlayerop
    wh += X.T.dot(d_hiddenlayer) *lr

    print ("-----------Epoch-", i+1, "Starts----------")
    print("Input: \n" + str(X))
    print("Actual Output: \n" + str(y))
    print("Predicted Output: \n" ,output)
    print ("-----------Epoch-", i+1, "Ends----------\n")
```

```
-----------Epoch- 1 Starts----------
Input:
[[0.66666667 1.        ]
 [0.33333333 0.55555556]
```

```
 [1.         0.66666667]]
Actual Output:
[[0.92]
 [0.86]
 [0.89]]
Predicted Output:
 [[0.86639502]
 [0.8574679 ]
 [0.86626687]]
-----------Epoch- 1 Ends----------

-----------Epoch- 2 Starts----------
Input:
[[0.66666667 1.        ]
 [0.33333333 0.55555556]
 [1.         0.66666667]]
Actual Output:
[[0.92]
 [0.86]
 [0.89]]
Predicted Output:
 [[0.86657426]
 [0.85764085]
 [0.86644858]]
-----------Epoch- 2 Ends----------

-----------Epoch- 3 Starts----------
Input:
[[0.66666667 1.        ]
 [0.33333333 0.55555556]
 [1.         0.66666667]]
Actual Output:
[[0.92]
 [0.86]
 [0.89]]
Predicted Output:
 [[0.86675191]
 [0.8578123 ]
 [0.86662869]]
-----------Epoch- 3 Ends----------

-----------Epoch- 4 Starts----------
Input:
[[0.66666667 1.        ]
 [0.33333333 0.55555556]
 [1.         0.66666667]]
Actual Output:
[[0.92]
```

```
 [0.86]
 [0.89]]
Predicted Output:
 [[0.86692801]
 [0.85798226]
 [0.86680721]]
-----------Epoch- 4 Ends----------

-----------Epoch- 5 Starts----------
Input:
[[0.66666667 1.        ]
 [0.33333333 0.55555556]
 [1.         0.66666667]]
Actual Output:
[[0.92]
 [0.86]
 [0.89]]
Predicted Output:
 [[0.86710257]
 [0.85815075]
 [0.86698417]]
-----------Epoch- 5 Ends----------
```

[22]:
```
print("Input: \n" + str(X))
print("Actual Output: \n" + str(y))
print("Predicted Output: \n" ,output)
```

```
Input:
[[0.66666667 1.        ]
 [0.33333333 0.55555556]
 [1.         0.66666667]]
Actual Output:
[[0.92]
 [0.86]
 [0.89]]
Predicted Output:
 [[0.86710257]
 [0.85815075]
 [0.86698417]]
```

EXPERIMENT 5

[6]:
```
import random
import numpy as np
```

```
def init_population(pop_size, genome_size):  # initialize the population of bit␣
 ↪vectors
    return [random.choices(range(2), k=genome_size) for _ in range(pop_size)]
```

[2]:
```
def fitness(individual):  # an individual's fitness is the number of 1s
    return sum(individual)
```

[3]:
```
def selection(population, fitnesses):  # tournament selection
    tournament = random.sample(range(len(population)), k=3)
    tournament_fitnesses = [fitnesses[i] for i in tournament]
    winner_index = tournament[np.argmax(tournament_fitnesses)]
    return population[winner_index]
```

[4]:
```
def crossover(parent1, parent2):  # single-point crossover
    xo_point = random.randint(1, len(parent1) - 1)
    return ([parent1[:xo_point] + parent2[xo_point:],
             parent2[:xo_point] + parent1[xo_point:]])

def mutation(individual):  # bitwise mutation with probability 0.1
    for i in range(len(individual)):
        if random.random() < 0.1:
            individual = individual[:i] + [1-individual[i]] + individual[i + 1:]
    return individual
```

[7]:
```
pop_size, genome_size = 6, 5
population = init_population(pop_size, genome_size)  # generation 0

for gen in range(10):
    fitnesses = [fitness(individual) for individual in population]
    print('Generation ', gen, '\n', list(zip(population, fitnesses)))
    nextgen_population = []
    for i in range(int(pop_size / 2)):
        parent1 = selection(population, fitnesses)  # select first parent
        parent2 = selection(population, fitnesses)  # select second parent
        offspring1, offspring2 = crossover(parent1, parent2)  # perform␣
 ↪crossover between both parents
        nextgen_population += [mutation(offspring1), mutation(offspring2)]  #␣
 ↪mutate offspring
    population = nextgen_population
```

```
Generation  0
 [([1, 0, 0, 0, 0], 1), ([1, 0, 0, 0, 0], 1), ([1, 1, 1, 1, 0], 4), ([0, 1, 0,
1, 1], 3), ([1, 1, 1, 1, 0], 4), ([1, 0, 0, 1, 1], 3)]
Generation  1
 [([1, 1, 1, 1, 0], 4), ([1, 1, 1, 1, 0], 4), ([1, 0, 1, 1, 0], 3), ([1, 1, 0,
1, 1], 4), ([0, 1, 1, 1, 1], 4), ([1, 1, 0, 1, 0], 3)]
Generation  2
```

```
 [([1, 1, 1, 1, 1], 5), ([0, 1, 1, 1, 0], 3), ([1, 1, 1, 1, 0], 4), ([1, 1, 1,
0, 0], 3), ([0, 1, 1, 1, 1], 4), ([1, 1, 0, 1, 1], 4)]
Generation  3
 [([1, 1, 0, 0, 1], 3), ([1, 1, 0, 1, 1], 4), ([1, 1, 0, 0, 0], 2), ([1, 1, 1,
1, 1], 5), ([0, 1, 0, 1, 1], 3), ([0, 1, 1, 1, 1], 4)]
Generation  4
 [([1, 1, 0, 1, 1], 4), ([1, 1, 1, 1, 1], 5), ([1, 1, 0, 1, 1], 4), ([0, 0, 0,
1, 1], 2), ([1, 1, 1, 1, 1], 5), ([0, 1, 0, 1, 1], 3)]
Generation  5
 [([1, 0, 0, 1, 1], 3), ([1, 1, 0, 1, 1], 4), ([1, 1, 1, 1, 1], 5), ([1, 1, 1,
1, 0], 4), ([1, 1, 0, 1, 1], 4), ([1, 1, 1, 1, 1], 5)]
Generation  6
 [([1, 1, 1, 1, 1], 5), ([0, 0, 1, 1, 1], 3), ([1, 1, 0, 1, 1], 4), ([1, 1, 1,
1, 1], 5), ([1, 1, 1, 1, 0], 4), ([0, 1, 1, 0, 1], 3)]
Generation  7
 [([0, 1, 1, 1, 1], 4), ([1, 0, 1, 0, 1], 3), ([1, 1, 0, 1, 1], 4), ([1, 1, 1,
1, 1], 5), ([1, 1, 1, 1, 1], 5), ([1, 1, 1, 1, 1], 5)]
Generation  8
 [([1, 1, 1, 1, 1], 5), ([1, 1, 1, 1, 1], 5), ([1, 1, 1, 1, 1], 5), ([0, 1, 1,
1, 1], 4), ([1, 1, 0, 1, 0], 3), ([1, 1, 1, 1, 0], 4)]
Generation  9
 [([1, 1, 0, 1, 1], 4), ([0, 1, 1, 1, 1], 4), ([1, 1, 1, 0, 0], 3), ([1, 0, 1,
1, 1], 4), ([1, 1, 1, 1, 1], 5), ([1, 0, 1, 1, 1], 4)]
```

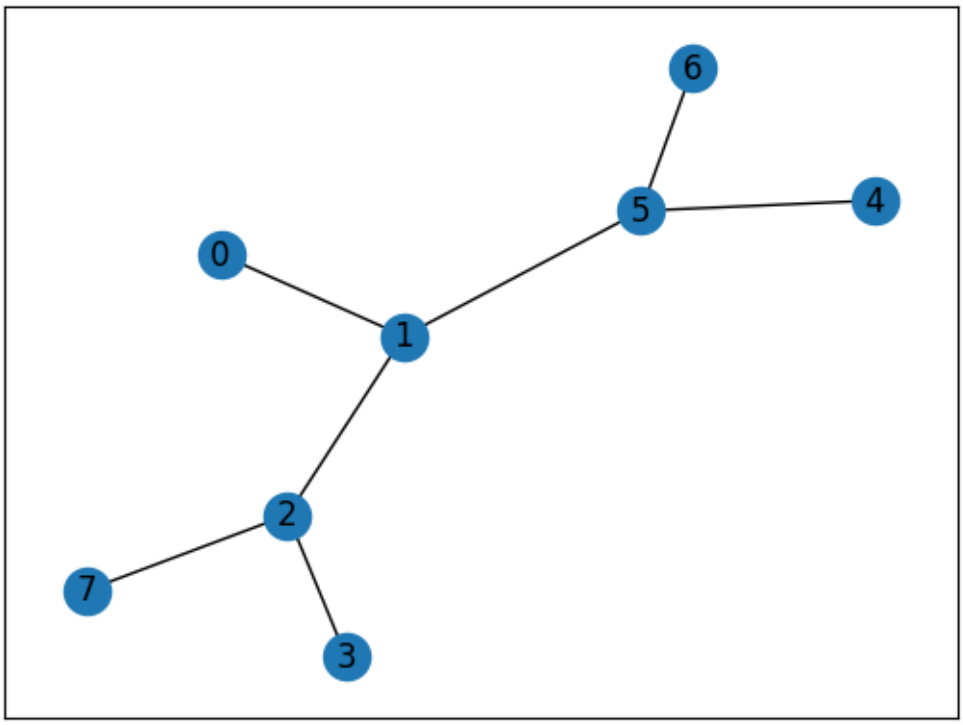
EXPERIMENT 6

[8]:
```
import numpy as np
import pylab as plt
```

[9]:
```
points_list =[(0,1),(1,5),(5,6),(5,4),(1,2),(2,3),(2,7)]
```

[10]:
```
goal = 7
```

[42]:
```
import networkx as nx
G=nx.Graph()
G.add_edges_from(points_list)
pos = nx.spring_layout(G)
nx.draw_networkx_nodes(G,pos)
nx.draw_networkx_edges(G,pos)
nx.draw_networkx_labels(G,pos)
plt.show()
```



[30]:
```
MATRIX_SIZE = 8

R = np.matrix(np.ones(shape=(MATRIX_SIZE,MATRIX_SIZE)))
R*=-1
```

[31]:
```
for point in points_list:
    print(point)
    if point[1] == goal:
        R[point] =100
    else:
        R[point]=0

    if point[0] == goal:
        R[point[::-1]]=100
    else:
        R[point[::-1]]=0

R[goal,goal]=100
```

```
(0, 1)
(1, 5)
(5, 6)
(5, 4)
(1, 2)
```

```
(2, 3)
(2, 7)
```

[32]:
```
Q = np.matrix(np.zeros([MATRIX_SIZE,MATRIX_SIZE]))
```

[33]:
```
gamma=0.8
```

[34]:
```
initial_state=1
```

[35]:
```
def available_actions(state):
    current_state_row = R[state,]
    av_act = np.where(current_state_row >=0)[1]
    return av_act
```

[36]:
```
available_act = available_actions(initial_state
                                  )
```

[37]:
```
def sample_next_action(available_actions_range):
    next_action = int(np.random.choice(available_act,1))
    return next_action
```

[38]:
```
action = sample_next_action(available_act)
```

[39]:
```
def update(current_state, action,gamma):
    max_index = np.where(Q[action,] == np.max(Q[action,]))[1]

    if max_index.shape[0] > 1:
        max_index = int(np.random.choice(max_index,size=1))
    else:
        max_index=int(max_index)
    max_value=Q[action,max_index]

    Q[current_state,action]=R[current_state,action] +gamma*max_value
    print('max_value',R[current_state,action]+gamma*max_value)

    if(np.max(Q)>0):
        return(np.sum(Q/np.max(Q)*100))
    else:
        return(0)

update(initial_state,action,gamma)
```

```
max_value 0.0
```

[39]:
```
0
```

[40]:
```
scores =[]

for i in range(700):
    current_state=np.random.randint(0,int(Q.shape[0]))
    available_act = available_actions(current_state)
    action =sample_next_action(available_act)
    score=update(current_state,action,gamma)
    scores.append(score)
    print("Score : ",str(score))
print("Trained Q Matrix:")
print(Q/np.max(Q)*100)

current_state=0
steps=[current_state]
```

```
max_value 0.0
Score :  0
max_value 0.0
Score :  0
max_value 0.0
Score :  0
max_value 100.0
Score :  100.0
max_value 100.0
Score :  200.0
max_value 80.0
Score :  280.0
max_value 64.0
Score :  344.0
max_value 0.0
Score :  344.0
max_value 180.0
Score :  235.55555555555554
max_value 0.0
Score :  235.55555555555554
max_value 80.0
Score :  280.0
max_value 0.0
Score :  280.0
max_value 0.0
Score :  280.0
max_value 64.0
Score :  280.0
max_value 244.0
Score :  232.78688524590163
max_value 0.0
Score :  232.78688524590163
```

```
max_value 0.0
Score :  232.78688524590163
max_value 0.0
Score :  232.78688524590163
max_value 295.20000000000005
Score :  209.7560975609756
max_value 0.0
Score :  209.7560975609756
max_value 336.1600000000001
Score :  196.3826749167063
max_value 0.0
Score :  196.3826749167063
max_value 368.92800000000005
Score :  251.8345042935207
max_value 295.14240000000007
Score :  331.8345042935207
max_value 0.0
Score :  331.8345042935207
max_value 0.0
Score :  331.8345042935207
max_value 236.11392000000006
Score :  395.8345042935207
max_value 295.14240000000007
Score :  454.1500563795646
max_value 0.0
Score :  454.1500563795646
max_value 236.11392000000006
Score :  518.1500563795646
max_value 0.0
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Score :  982.1456668876117
max_value 399.91692325026355
Score :  982.149821587996
max_value 399.91692325026355
Score :  982.1539762883804
max_value 399.91692325026355
Score :  982.1539762883804
max_value 319.93353860021085
Score :  982.1573000486878
max_value 399.91692325026355
Score :  982.1573000486878
max_value 255.93353860021085
Score :  982.1573000486878
max_value 499.8961540628294
Score :  982.1573000486878
max_value 499.8961540628294
Score :  982.1573000486878
max_value 255.93353860021085
Score :  982.1573000486878
```
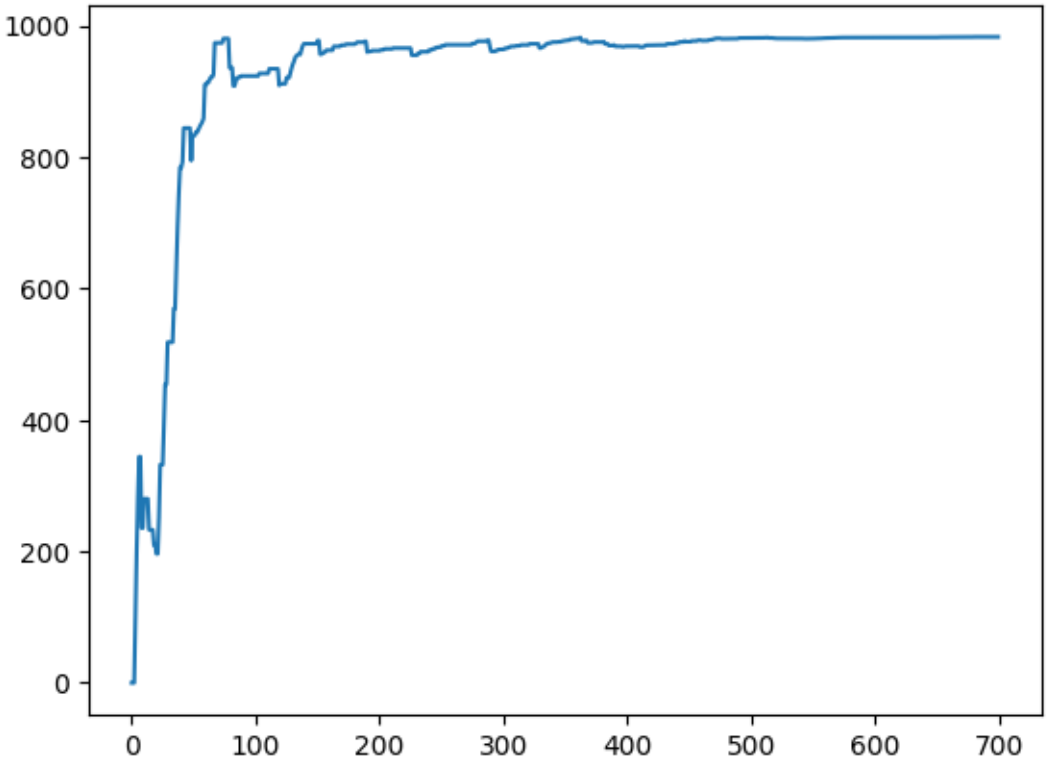

```
max_value 399.91692325026355
Score :  982.1573000486878
max_value 255.93353860021085
Score :  982.1573000486878
max_value 319.93353860021085
Score :  982.1606238089953
max_value 399.91692325026355
Score :  982.1606238089953
max_value 255.93353860021085
Score :  982.1797873645182
max_value 399.91692325026355
Score :  982.1797873645182
max_value 255.9468308801687
Score :  982.1824463727642
max_value 255.9468308801687
Score :  982.3265849901281
max_value 255.9468308801687
Score :  982.3265849901281
max_value 255.9468308801687
Score :  982.3265849901281
max_value 204.75746470413497
Score :  982.4418958840193
max_value 499.8961540628294
Score :  982.4470892594998
max_value 255.9468308801687
Score :  982.4470892594998
max_value 399.91692325026355
Score :  982.4470892594998
max_value 499.91692325026355
Score :  982.4104277500664
max_value 255.9468308801687
Score :  982.5545603791516
max_value 255.9468308801687
Score :  982.5545603791516
max_value 255.9468308801687
Score :  982.5545603791516
max_value 255.9468308801687
Score :  982.5545603791516
max_value 255.9468308801687
Score :  982.5545603791516
max_value 204.75746470413497
Score :  982.5545603791516
max_value 204.75746470413497
Score :  982.5545603791516
max_value 255.9468308801687
Score :  982.5545603791516
max_value 319.93353860021085
Score :  982.5545603791516
```

```
max_value 399.91692325026355
Score :  982.5587149069277
max_value 255.9468308801687
Score :  982.5587149069277
max_value 399.91692325026355
Score :  982.5587149069277
max_value 399.91692325026355
Score :  982.5587149069277
max_value 399.91692325026355
Score :  982.5587149069277
max_value 255.9468308801687
Score :  982.5587149069277
max_value 319.93353860021085
Score :  982.5620385291486
max_value 499.93353860021085
Score :  982.5327064760093
max_value 255.9468308801687
Score :  982.5327064760093
max_value 399.91692325026355
Score :  982.5327064760093
max_value 319.93353860021085
Score :  982.5327064760093
max_value 255.9468308801687
Score :  982.5327064760093
Trained Q Matrix:
[[  0.          63.99521414   0.           0.           0.
    0.           0.           0.        ]
 [ 51.19351251   0.          79.99401768   0.           0.
   51.19617131   0.           0.        ]
 [  0.          63.99189063   0.          63.99521414   0.
    0.           0.          99.9925221 ]
 [  0.           0.          79.99401768   0.           0.
    0.           0.           0.        ]
 [  0.           0.           0.           0.           0.
   51.19617131   0.           0.        ]
 [  0.          63.99521414   0.           0.          40.95693705
    0.          40.84163478   0.        ]
 [  0.           0.           0.           0.           0.
   51.19617131   0.           0.        ]
 [  0.           0.          79.99401768   0.           0.
    0.           0.         100.        ]]
```

[41]:
```
while current_state !=7:
    next_step_index = np.where(Q[current_state,]==np.max(Q[current_state]))[1]
    if next_step_index.shape[0] > 1:
        next_step_index = int(np.random.choice(next_step_index, size=1))
    else:
```

```
        next_step_index = int(next_step_index)

    steps.append(next_step_index)
    current_state = next_step_index



print("Most Efficient Path: ")
print(steps)


plt.plot(scores)
plt.show()
```

```
Most Efficient Path:
[0, 1, 2, 7]
```



[ ]: